



# RH1078M

## Micropower, Dual, Single Supply Precision Op Amp

### DESCRIPTION

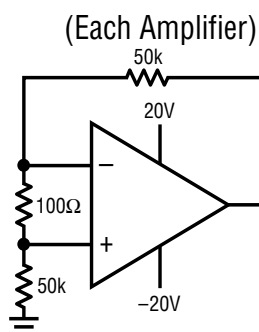
The RH1078M is a micropower dual op amp in the standard 8-pin configuration. This device is optimized for single supply operation at 5V. Specifications for  $\pm 15V$  are also provided.

The wafer lots are processed to LTC's in-house Class S flow to yield circuits usable in stringent military applications.

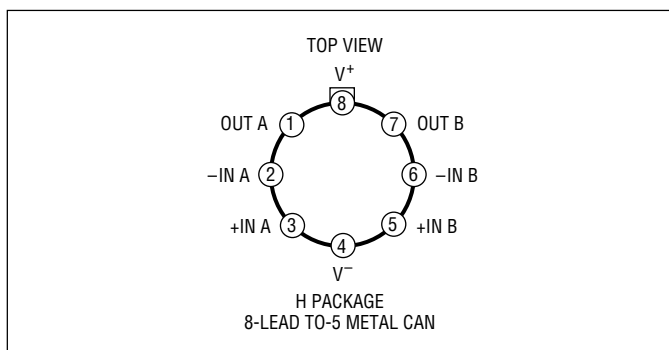
### ABSOLUTE MAXIMUM RATINGS

Supply Voltage .....	$\pm 22V$
Differential Input Voltage .....	$\pm 30V$
Input Voltage .....	Equal to Positive Supply Voltage
.....	0.5V Below Negative Supply Voltage
Output Short-Circuit Duration .....	Indefinite
Operating Temperature Range .....	$-55^{\circ}C$ to $125^{\circ}C$
Storage Temperature Range .....	$-55^{\circ}C$ to $150^{\circ}C$
Lead Temperature (Soldering, 10 sec) .....	$300^{\circ}C$

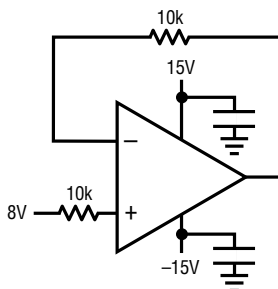
### BURN-IN CIRCUIT



### PACKAGE/ORDER INFORMATION



### TOTAL DOSE BIAS CIRCUIT



Note: For ordering information contact LTC.

**TABLE 1: ELECTRICAL CHARACTERISTICS** (Preirradiation) $V_S = 5V$ ,  $V_{CM} = 0.1V$ ,  $V_{OUT} = 1.4V$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	NOTES	$T_A = 25^\circ C$			SUB-GROUP	$-55^\circ C \leq T_A \leq 125^\circ C$			SUB-GROUP	UNITS
				MIN	TYP	MAX		MIN	TYP	MAX		
$V_{OS}$	Input Offset Voltage					120	4			370	2, 3	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Tempco of Offset Voltage								0.5			$\mu V/^\circ C$
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term $V_{OS}$ Stability				0.5							$\mu V/Month$
$I_{OS}$	Input Offset Current					0.8	1			1.5	2, 3	nA
$I_B$	Input Bias Current					15	1			18	2, 3	nA
$e_n$	Input Noise Voltage	0.1Hz to 10Hz	1		0.5							$\mu V/P-P$
	Input Noise Voltage Density	$f_0 = 10Hz$ $f_0 = 1kHz$	1 1		25 24							$nV/\sqrt{Hz}$ $nV/\sqrt{Hz}$
$i_n$	Input Noise Current	0.1Hz to 10Hz	1		2.6							pA/P-P
	Input Noise Current Density	$f_0 = 10Hz$ $f_0 = 1kHz$	1 1		0.07 0.025							$pA/\sqrt{Hz}$ $pA/\sqrt{Hz}$
$R_{IN}$	Input Resistance Differential		2		600							M $\Omega$
	Common Mode		2		5							G $\Omega$
	Input Voltage Range		2 2	3.5 0			1 1	3.20 0.05			2, 3 2, 3	V V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0V$ to 3.5V $V_{CM} = 0.05V$ to 3.2V		94			1	88			2, 3	dB dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.3V$ to 12V $V_S = 3.1V$ to 12V		100			1	94			2, 3	dB dB
$A_{VOL}$	Large-Signal Voltage Gain	$V_O = 0.03V$ to 4V, No Load		150			1					V/mV
		$V_O = 0.03V$ to 3.5V, $R_L = 50k$		120			1					V/mV
		$V_O = 0.05V$ to 4V, No Load						80			2, 3	V/mV
		$V_O = 0.05V$ to 3.5V, $R_L = 50k$						60			2, 3	V/mV
$V_{OUT}$	Output Voltage Swing	Output Low, No Load				6	4			8	5, 6	mV
		Output Low, 2k to GND				2	4					mV
		Output Low, $I_{SINK} = 100\mu A$				130	4			170	5, 6	mV
		Output High, No Load		4.2			4	3.9			5, 6	V
		Output High, 2k to GND		3.5			4	3.0			5, 6	V
SR	Slew Rate	$A_V = 1$ , $V_S = \pm 2.5V$		0.04			4					V/ $\mu s$
GBW	Gain-Bandwidth Product	$f_0 \leq 20kHz$			200							kHz
$I_S$	Supply Current	per Amplifier				75	1			95	2, 3	$\mu A$
	Channel Separation	$\Delta V_{IN} = 3V$ , $R_L = 10k$				130						dB
	Minimum Supply Voltage		3			2.3						V

**TABLE 1: ELECTRICAL CHARACTERISTICS** (Preirradiation) $V_S = \pm 15V$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	NOTES	$T_A = 25^\circ C$			SUB-GROUP	$-55^\circ C \leq T_A \leq 125^\circ C$			SUB-GROUP	UNITS
				MIN	TYP	MAX		MIN	TYP	MAX		
$V_{OS}$	Input Offset Voltage					350	4			600	2, 3	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Tempco of Offset Voltage								0.6			$\mu V/^\circ C$
$I_{OS}$	Input Offset Current					0.8	1			1.5	2, 3	nA
$I_B$	Input Bias Current					15				18	2, 3	nA
	Input Voltage Range			13.5		-15.0	1					V
							1					V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 13.5V, -15V$		97			1					dB
		$V_{CM} = 13V, -14.9V$						90			2, 3	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$		100			1	94			2, 3	dB
$A_{VOL}$	Large-Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$		1000			1					V/mV
		$V_O = \pm 10V, R_L = 2k$		300			1					V/mV
		$V_O = \pm 10V, R_L = 5k$						150			2, 3	V/mV
$V_{OUT}$	Output Voltage Swing	$R_L = 50k$		$\pm 13$			4					V
		$R_L = 2k$		$\pm 11$			4					V
		$R_L = 5k$						$\pm 11$			5, 6	V
SR	Slew Rate			0.06			4					V/ $\mu s$
$I_S$	Supply Current	Per Amplifier				100	1			125	2, 3	$\mu A$

**Note 1:** All noise parameters are for  $V_S = \pm 2.5V$ ,  $V_O = 0V$ .**Note 2:** This parameter is guaranteed by design, characterization or correlation to other tested parameters.**Note 3:** Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.8V supply but with a typical offset skew of  $-300\mu V$ .

**TABLE 1A: ELECTRICAL CHARACTERISTICS** (Postirradiation) $V_S = 5V$ ,  $0V$ ,  $V_{CM} = 0.1V$ ,  $V_O = 1.4V$ ,  $T_A = 25^\circ C$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	10KRAD(Si)		25KRAD(Si)		50KRAD(Si)		75KRAD(Si)		100KRAD(Si)		UNITS
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$V_{OS}$	Input Offset Voltage			120		175		250		500			$\mu V$
$I_{OS}$	Input Offset Current			2		8		13		18			nA
$I_B$	Input Bias Current			20		40		80		100			nA
	Input Voltage Range		3.5		3.5		3.5		3.5				V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0V$ to $3.5V$	91		89		87		85				dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.3V$ to $12V$	100		100		98		88				dB
$A_{VOL}$	Large-Signal Voltage Gain	$V_O = 0.03V$ to $4V$ , No Load $V_O = 0.03V$ to $3.5V$ , $R_L = 50k$	150 120		150 50		100 20		50 10				V/mV V/mV
$V_{OUT}$	Output Voltage Swing	Output Low, No Load		6		9		13		20			mV
		Output Low, 2k to GND		2		2		2		2			mV
		Output Low, $I_{SINK} = 100\mu A$		130		140		150		160			mV
		Output High, No Load	4.2		4.2		4.2		4.2				V
		Output High, 2k to GND	3.5		3.5		3.5		3.5				V
$S_R$	Slew Rate	$A_V = 1$ , $V_S = \pm 2.5V$	0.04		0.03		0.02		0.01				V/ $\mu s$
$I_S$	Supply Current	per Amplifier		75		75		75		75			$\mu A$

**TABLE 1A: ELECTRICAL CHARACTERISTICS** (Postirradiation) $V_S = \pm 15V$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	10KRAD(Si)		25KRAD(Si)		50KRAD(Si)		75KRAD(Si)		100KRAD(Si)		UNITS
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$V_{OS}$	Input Offset Voltage			350		500		650		800		1000	$\mu V$
$I_{OS}$	Input Offset Current			2		8		13		18		23	nA
$I_B$	Input Bias Current			20		40		80		100		120	nA
	Input Voltage Range		13.5		13.5		13.5		13.5		13.5		V
			-15.0		-15.0		-15.0		-15.0		-15.0		V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 13.5V, -15V$		94		92		90		88		86	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$		100		100		98		88		78	dB
$A_{VOL}$	Large-Signal Voltage Gain	$V_O = 10V, R_L = 50k$		1000		700		400		150		50	V/mV
		$V_O = 10V, R_L = 2k$		300		200		120		45		15	V/mV
$V_{OUT}$	Output Voltage Swing	$R_L = 50k$		$\pm 13$		$\pm 13$		$\pm 13$		$\pm 13$		$\pm 13$	V
		$R_L = 2k$		$\pm 11$		$\pm 11$		$\pm 11$		$\pm 11$		$\pm 10$	V
SR	Slew Rate			0.05		0.04		0.03		0.02		0.01	V/ $\mu s$
$I_S$	Supply Current	per Amplifier		100		100		100		100		100	$\mu A$

TABLE 2: ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
Final Electrical Test Requirements (Method 5004)	1*,2,3,4,5,6
Group A Test Requirements (Method 5005)	1,2,3,4,5,6
Group C and D End Point Electrical Parameters (Method 5005)	1,2,3

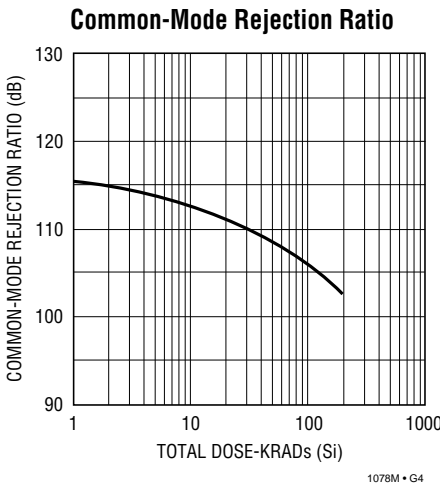
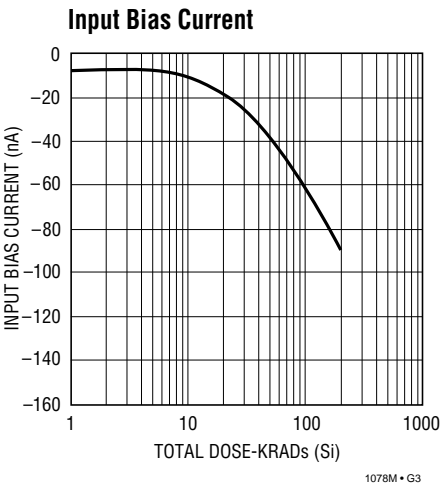
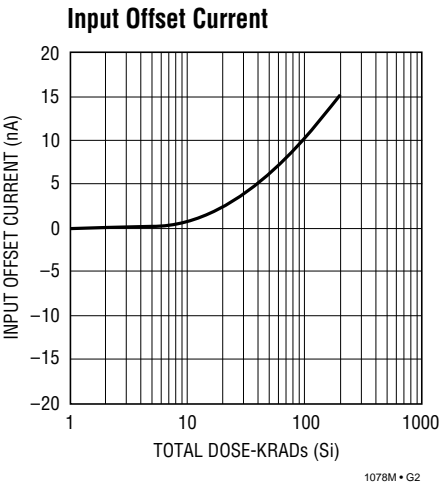
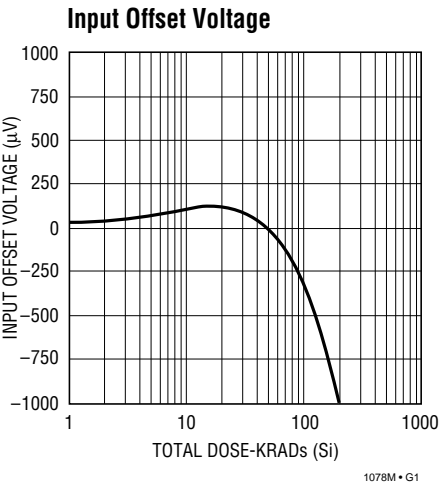
\* PDA Applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

The PDA is specified as 5% based on failures from group A, subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883 Class B. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

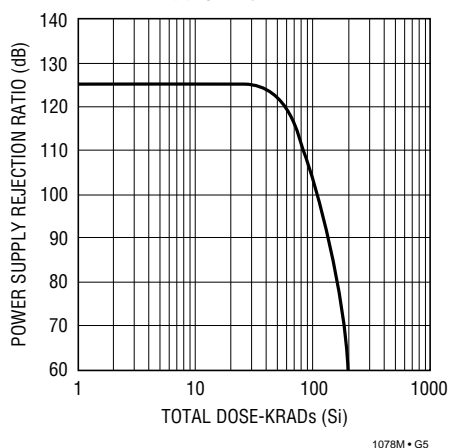
Linear Technology Corporation reserves the right to test to tighter limits than those given.

TYPICAL APPLICATIONS

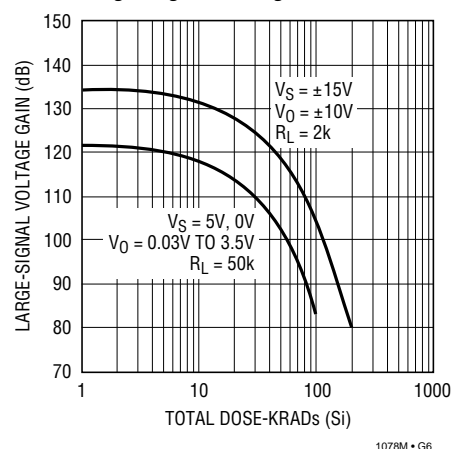


## TYPICAL APPLICATIONS

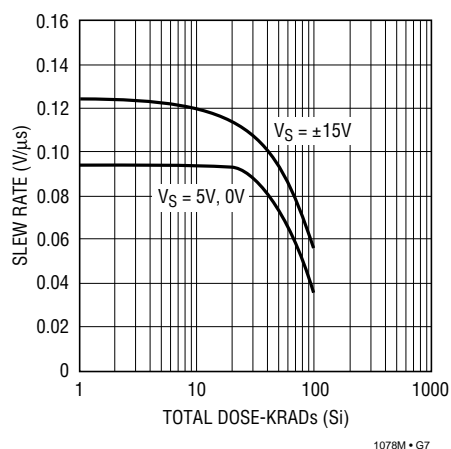
### Power Supply Rejection Ratio



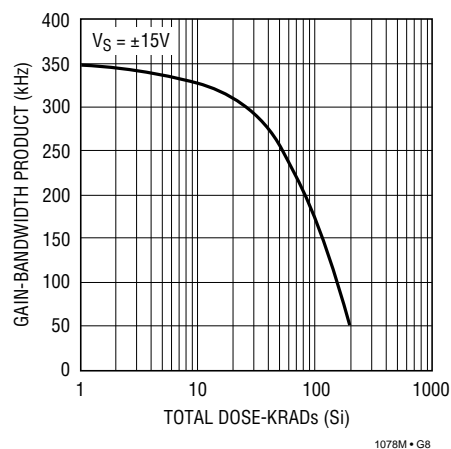
### Large-Signal Voltage Gain



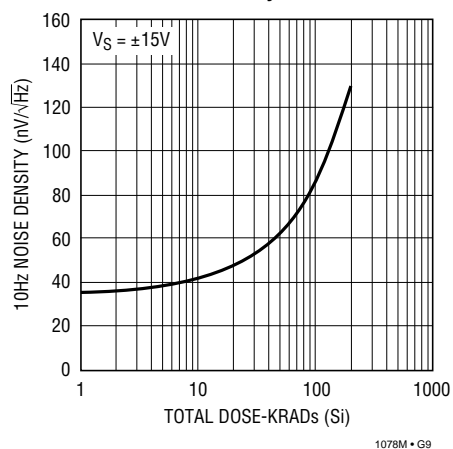
### Slew Rate



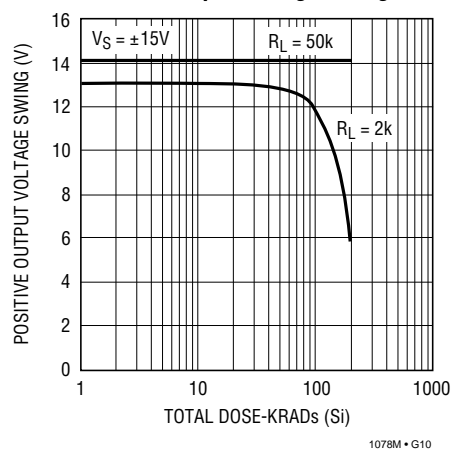
### Gain-Bandwidth Product



### 10Hz Noise Density

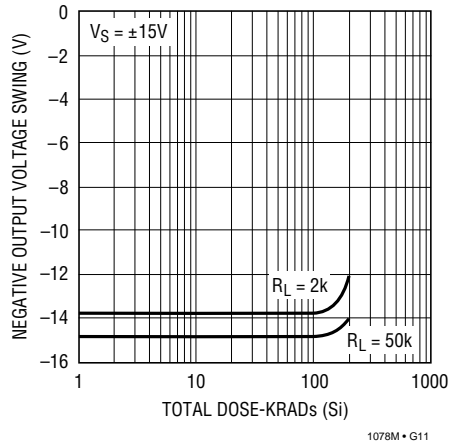


### Positive Output Voltage Swing

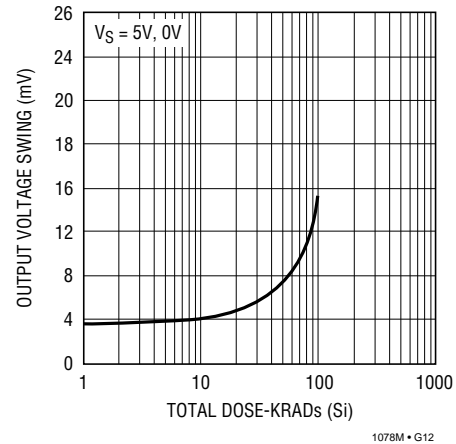


## TYPICAL APPLICATIONS

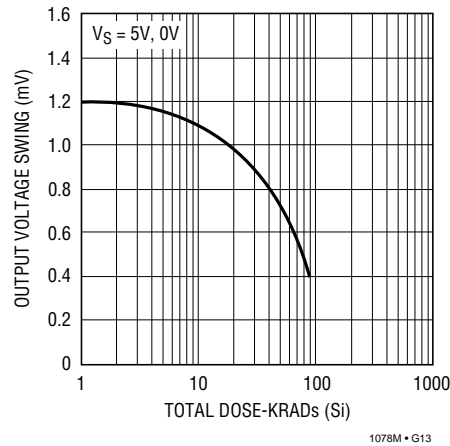
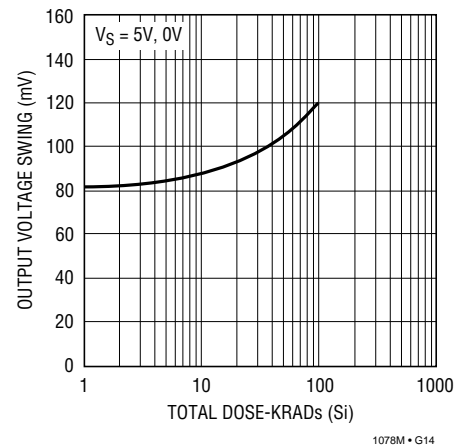
Negative Output Voltage Swing



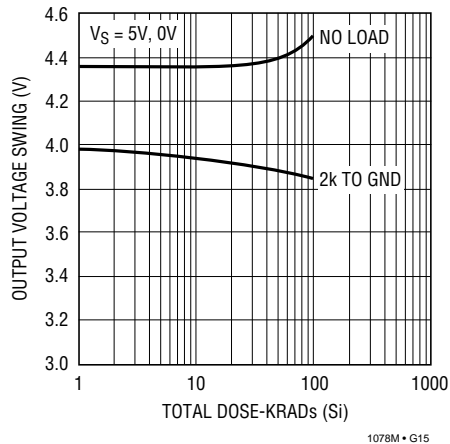
Output Voltage Swing Low, No Load



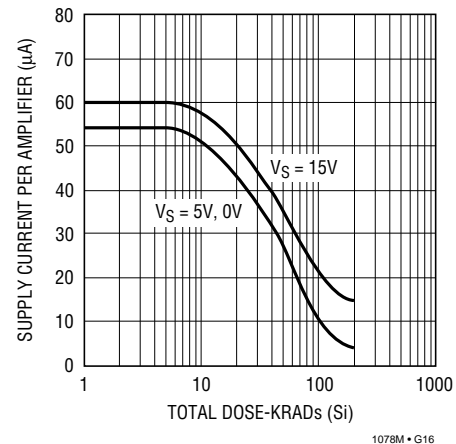
Output Voltage Swing Low, 2k to GND

Output Voltage Swing Low,  $I_{SINK} = 100mA$ 

Output Voltage Swing High



Supply Current



I.D. No. 66-10-0100 Rev. E 0798

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